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TECHNOLOGY

# INNOVATION



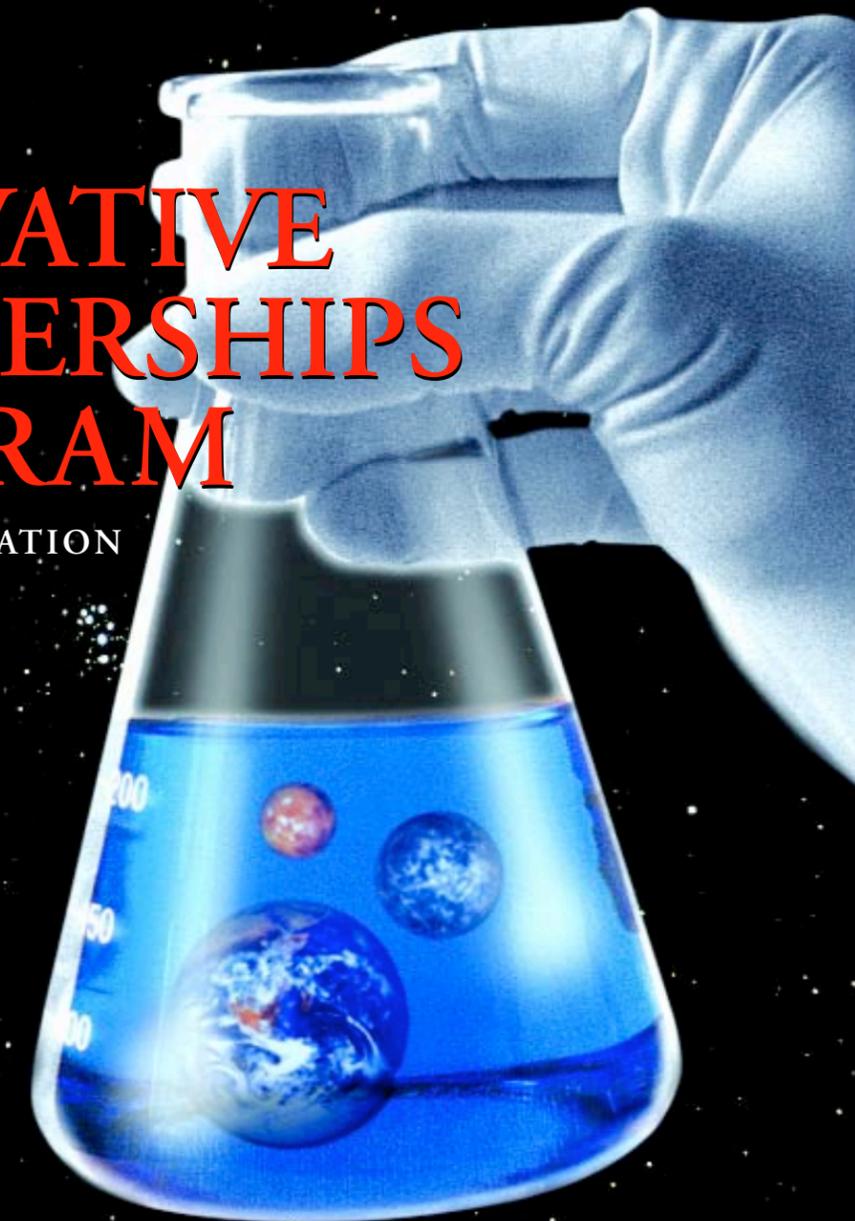
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION'S MAGAZINE FOR BUSINESS & TECHNOLOGY

FROM THE LABORATORY TO THE UNIVERSE:

THE ROLE OF THE

## INNOVATIVE PARTNERSHIPS PROGRAM

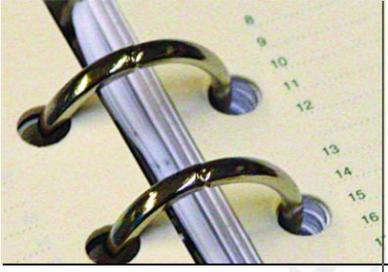
IN SPACE EXPLORATION



**PLUS**

Software Links  
Pediatricians  
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Innovative Technologies  
Earn R&D 100 Awards



# Upcoming Events

## Aug. 18: SBIR/STTR Contractors - SBIR Workshop, San Francisco/San Jose, Calif.

Tech BizSolutions Inc., national experts in contract management and government accounting, will present a workshop that highlights opportunities associated with the SBIR program. Subjects also will include Government data/patent rights, subcontractors under a federal government prime contract, FAR clauses in government contracts and business strategies for operating in a government contract environment.

[www.techbizsolutions.us](http://www.techbizsolutions.us)

## Oct. 25 - 27: Instrumentation Systems and Automation (ISA) Expo Conference and Exhibition, Chicago, Ill.

The expo is an opportunity for automation and control professionals to exchange information and ideas. ISA EXPO 2005 features the latest and most extensive products and services exhibition, a strategically relevant technical conference and a prominent continuing education and training program. With practitioners from over 70 countries, ISA EXPO 2005 offers the most complete automation and control experience in today's marketplace.

<http://www.isa.org>

## Dec. 6 - 8: SensorsGOV Expo & Conference, Hampton, Va.

SensorsGov will focus on such topics as border and transportation security, information analysis, infrastructure protection and emergency preparedness and response. Attendees will have the opportunity to meet the most influential audience of sensor buyers from government and military organizations to gather anywhere, representing substantial and growing business opportunities for sensors manufacturers.

<http://www.sensorsgov.com>

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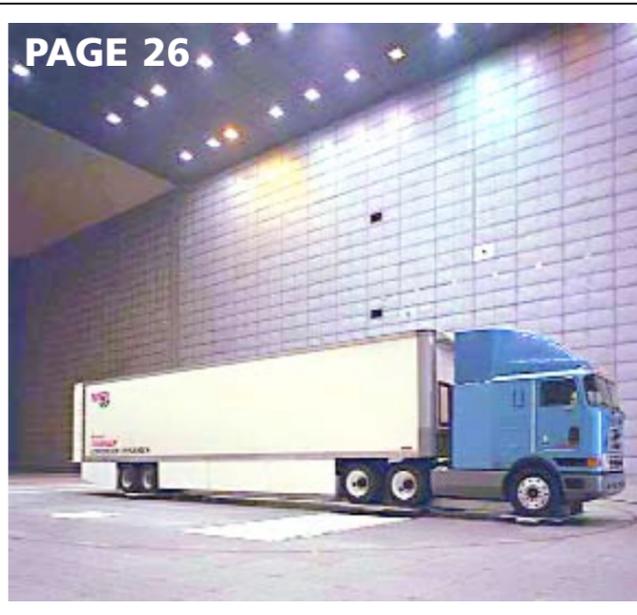


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**CHIEF EDITOR**  
Janelle Turner  
[innovation@hq.nasa.gov](mailto:innovation@hq.nasa.gov)

**EXECUTIVE EDITOR**  
Steven Infanti

**MANAGING EDITOR**  
Michele Rejonis

**RESEARCH**  
Tara Patterson  
Michele Rejonis

**ART DIRECTOR/PRODUCTION**  
Dennis Packer

**ONLINE EDITORS**  
Kathryn Duda  
Michele Rejonis

**CONTRIBUTORS**  
Debbie Avila  
Michael Braukus  
Kevin Cook  
Kathryn Duda  
Katherine K. Martin  
Michael Mewhinney  
Jesse Midgett  
Michael Moore  
Tara Patterson  
Robert Reid  
Frank Schowengerdt  
Jim Smith  
Laurel Stauber  
Victoria Steiner  
Lisa Williams

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A Message from NASA

UPFRONT with...

Dr. Frank Schowengerdt

Associate Director for Innovative Partnerships  
Exploration Systems Research & Technology Division  
Exploration Systems Mission Directorate  
NASA Headquarters

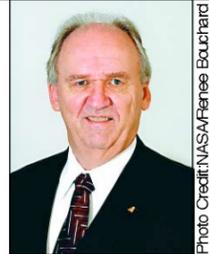


Photo Credit: NASA/Fennee Bouchard

A VISION OF HOPE

At long last, NASA and the nation have a vision for our future in space. It's not the first one we've had, but for many of us who can remember President John F. Kennedy's ringing call to "land a man on the moon and bring him back safely in this decade," it's one that can be every bit as much a vision of hope.

In the 1960s we were mired in an intractable war that divided us, we were struggling to live up to our constitutional promise of equal treatment for all and we were fearful of losing our scientific and technical leadership. The nation was destabilized by assassinations of its best leaders and by riots in every major city. In the midst of that turmoil, our spirits were lifted and we were filled with hope that we could all work together in an endeavor that would move mankind off this planet for the first time in our history and return immeasurable benefits for all.

That other vision encouraged thousands of young people to enter fields of science, mathematics and engineering. I was one of those people. Like many others I was filled with pride when the first astronauts set foot on the moon and I was deeply gratified in the knowledge that the space program was delivering important benefits to people back here on Earth at the same time. Most important of all, I sensed that it was providing a focus on what united us rather than what divided us.

But somewhere along the way we lost that focus. To be sure, we have accomplished many amazing feats in space since then, and we're still reaping the benefits, but in the midst of our troubles we forgot how the space program had motivated a whole generation and we abandoned the vision of permanently moving mankind off this planet.

The parallels between our situations then and now are striking. Now we're immersed in a war on terror that threatens our stability, we're in danger of losing our technical leadership because enrollments in scientific fields are once again declining and we're a nation divided on a host of issues.

That's why the announcement by President George W. Bush of a new vision for space exploration was such a welcome one. The goals of the new vision state very clearly and succinctly why we explore and how it can benefit our country. Those statements ring especially true to those of us who lived through the Apollo era.

In many ways the new vision is even more exciting than the old one because it's so fundamentally different - this time we're going to stay! It's not a crash program with fixed timelines. It truly is going to be a journey, not a destination. And because it represents a permanent change in the way we think about space, it's a vision that can motivate generations for years to come. It can lift our spirits like the first one did.

We can sustain the vision this time if we remember one of the most important lessons we thought we learned back then; that as we seek "to extend life to there" we must never forget that we're also called "to improve life here." Exploration of space accelerates innovation on Earth.

That's the thrust of this issue's cover story. That's the way to make the Vision for Space Exploration a vision of hope.



# NASA News Briefs

## NASA, TECHNOLOGY TRANSFER AND INDUSTRY-RELATED NEWS

### NASA Partners with Private Sector for Economic Growth

NASA's Glenn Research Center and two leading private sector partners announced an alliance to stimulate regional and statewide economic growth through development and transfer of new technologies. Glenn, Battelle's Great Lakes Industrial Technology Center (GLITeC), and the Ohio Aerospace Institute (OAI) announced the establishment of the Glenn Alliance for Technology Exchange.

Under the leadership of Glenn's director, Dr. Julian Earls, Glenn is continuing its "Journey to Tomorrow" by implementing recommendations from Northeast Ohio leaders that it become a leading-edge research and development center. The recommendations include forging partnerships with higher education and industry to contribute to national research excellence and industrial commercial adaptation and use.

"The alliance will strengthen our ability to improve Glenn's impact with new products and processes and will also contribute significantly to NASA's mission requirements in aerospace," says Earls.

"The importance of Glenn to the region and state cannot be overem-

phasized," says Dorothy Baunach, president and executive director of Northeast Ohio Technology Coalition (NorTech). "This was clearly the main driver for the sponsors of the original study. Glenn is to be commended for its responsiveness to the study, and both OAI and GLITeC have shown a true spirit of collaboration in stepping

**"The beauty of this effort is that it will invest money directly in technology, not infrastructure, because it builds on the existing capabilities of the partners"**

up to manage the effort."

Specific efforts soon to be undertaken by the alliance include:

- Identify and establish a Research and Technology Platform, and conduct several demonstration projects within a field of technology of high interest to both Glenn and Northeast Ohio.
- Fund small and early-stage Ohio companies to further develop Glenn technologies.
- Match Glenn-created technologies to Ohio companies for commercial development and application.
- Provide Glenn's technology assistance to solve specific problems faced by Ohio industry.
- Establish a Glenn Technology Partnership Fund to facilitate the co-development of technologies with

Ohio companies to help meet NASA mission needs.

- Attract supplemental funding to support activities within the alliance.

"Working with GLITeC to implement the Glenn Alliance will benefit not only NASA Glenn, but also the entire state of Ohio, Northeast Ohio and our local area. The beauty of this

effort is that it will invest money directly in technology, not infrastructure, because it builds on the existing capabilities of the partners," says William R. Seelbach, President and CEO of OAI.

In 2002, the Ohio Aerospace Council (OAC), with the financial support of more than 16 corporate and private foundations, including the Generation Foundation, commissioned the Battelle Technology Partnership Practice to create a roadmap showing how Glenn could be utilized to provide momentum for Northeast Ohio's economy. A key recommendation of the report was the creation of a Glenn Commercialization Center. NorTech and OAC, working with the Greater

Cleveland Growth Association/ Greater Cleveland Partnership, were able to secure a \$2 million federal appropriation in FY2004 for the creation of the Center. In late fall, OAI and Battelle's proposal to jointly create and manage a center, renamed the Glenn Alliance for Technology Exchange, received approval from NASA.

"OAI, under the leadership of Bill Seelbach, is the right partner in our mission to enhance NASA's impact on the local economy," says Priscilla Diem, program manager for Battelle. "Powered by this new alliance, GLITeC intends to increase NASA's economic impact in the region by 25 percent over what has been accomplished to date."

The Glenn Alliance for Technology Exchange will be led by OAI, and overseen by an Advisory Board comprised of representatives from Glenn, NorTech, OAI and Battelle. ■

*For more information, contact Laurel Stauber, Glenn Research Center, (216) 433-2820, laurel.j.stauber@grc.nasa.gov.*

*Please mention that you read about it in Technology Innovation.*

### NASA, SpaceDev Collaborating on Future Space Transportation

NASA's Ames Research Center in Moffett Field, Calif., and SpaceDev Inc., of Poway, Calif., are developing new low-cost space launch vehicles to help achieve the goals of the nation's Vision for Space Exploration.

Under the terms of a memorandum of understanding (MOU), SpaceDev, a nationally recognized leader in the development of hybrid propulsion systems, will partner with NASA to explore designs for small, piloted launch vehicles and flight test platforms, which will enable near-term, low-cost, routine space access for future exploration.

"I am delighted that we will be working with SpaceDev to help meet the goals of the Vision for Space Exploration," says G. Scott Hubbard, Ames director. "Near-term, low-cost, piloted and unpiloted routine space access is a key for realizing the nation's exploration vision. I look forward to a long and fruitful partnership with SpaceDev to explore the technologies for a new class of exciting launch vehicles for future space exploration."

The MOU points out several potential areas of collaboration, including vehi-

cle concept analyses; hybrid propulsion systems; systems engineering; detailed design; fabrication; re-entry analyses and design; thermal protection systems; information technology; vehicle health monitoring; advanced hybrid propulsion fuels; wind tunnel, arc-jet facilities and flight simulator use; and experimental design and integration.

"We are pleased to be a partner with NASA in helping the nation achieve low-cost, routine access to space," says Jim Benson, SpaceDev's founding chairman and chief executive officer. "We believe that our expertise in hybrid propulsion technology, combined with NASA's hypersonic flight tests and the use of its world-class facilities, will provide an important new opportunity for meeting the nation's space-access needs."

Founded in 1997, SpaceDev designed and built a hybrid propulsion system for SpaceShipOne, the privately funded space vehicle that completed a successful launch in Mojave, Calif., in June 2004. Company officials say that hybrid propulsion provides a level of safety, low costs and operational flexibility that are unmatched by conventional liquid-fueled or solid-rocket motors. ■

*For more information, contact Phil Herlth, Ames Research Center, (650) 604-0625, Philip.M.Herlth@nasa.gov.*

*Please mention that you read about it in Technology Innovation.*

# NASA News Briefs

# Looking Back

A FOLLOW-UP ON A NASA SUCCESS

## NASA and IVEK Corp. Enter into License Agreement

Drug delivery and laboratory automation might soon be significantly more accurate, efficient, reliable and cost effective, thanks to a wafer-thin diaphragm developed by NASA for use in the space program.

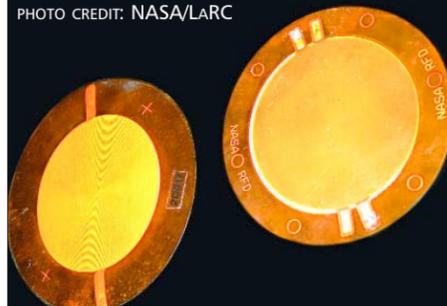
IVEK Corp., a manufacturer of precision small-volume fluid metering and dispensing systems, has licensed the Radial Field Diaphragm (RFD) from NASA's smart materials research area. The RFD is a unique fluid-control device that offers significant potential for accurate small-volume handling of liquids. The agreement was reached with the assistance of the Robert C. Byrd National Technology Transfer Center (NTTC), a full-service provider of technology-management services headquartered at Wheeling Jesuit University in Wheeling, W.Va.

Most fluid-controlling diaphragms on the market are configured for low-volume, low-flow precision pumping and dispensing, and have strictly medical applications. NASA's RFD, however, has broad potential in a variety of applications as a pump, a valve, a sensor or all three simultaneously. Vermont-based IVEK plans to refine the diaphragm for commercial use in specific markets and products.

Potential uses include measuring and dispensing liquids in the medical, pharmaceutical and cosmetic industries, in food and chemical processing and in semiconductor manufacturing.

One of the RFD's main advantages is that it has only one solid-state moving part, a flexible piezoelectric diaphragm, to pump and move liquid. This feature improves reliability, efficiency and cost-effectiveness, which

PHOTO CREDIT: NASA/LARC



THE RADIAL FIELD DIAPHRAGM LICENSED BY IVEK CORP. FROM NASA'S SMART MATERIALS RESEARCH AREA.

are common shortcomings of multiple-component mechanical devices. The RFD is part of NASA's continuing research in synthetic jets, in which tiny air pumps change the airflow over a wing for enhanced aircraft performance.

The RFD's journey into the public arena originated from the NTTC's NASA Partnership Opportunities initiative. The initiative facilitates partnerships between NASA and industry, research institutions and other government agencies, yielding technologies

that not only benefit the space program but also become new commercial products. With the RFD, the NTTC facilitated initial communications between NASA Langley Research Center in Hampton, Va., and IVEK, and then helped prepare an agreement and a license application for the device.

"NASA Langley is proud of its long history of developing innovative technologies for NASA's space exploration and aerospace programs. Our technology transfer program is committed to transferring cutting-edge technologies to U.S. industry," says NASA Technology Transfer Manager Marisol Garcia. "The Radial Field Diaphragm technology is the latest in the family of smart material actuators that has evolved from our piezoelectric research. We are happy to be working with IVEK in bringing this technology to a commercial market for volume fluid handling and metering applications." ■

*For more information, contact Bill Chard, Robert C. Byrd National Technology Transfer Center, (800) 678-6882, wchard@nttc.edu.*

*Please mention that you read about it in Technology Innovation.*

## Protective Ceramic Coating Cools and Cuts Costs

When NASA scientists created a protective coating for ceramic materials (PCCM) for use in heat shields on space vehicles, they probably did not envision the technology used in the automotive industry. However, testing showed other possibilities for the coating, which absorbs energy to a cooler surface in turn providing greater energy efficiency and protection.

PCCM was originally developed for use with the next generation of Space Orbiters to protect against extreme conditions upon re-entry. In 1996, Ames Research Center entered into a partial-use license agreement with Wessex Incorporated of Blacksburg, Va. for the technology. In 2001, the agreement grew into an exclusive license and expanded commercial potential. Emisshield, the name Wessex assigned to its PCCM product, is used in a variety of industries: building materials, metal and refractory coatings, automotive and military applications.

Wessex has had a great deal of success with Emisshield, most notably in industry where the product has provided energy savings, corrosion control and improved thermal heat transfer in furnace/kiln applications. When applied to various automotive parts, the coating has been proven to increase

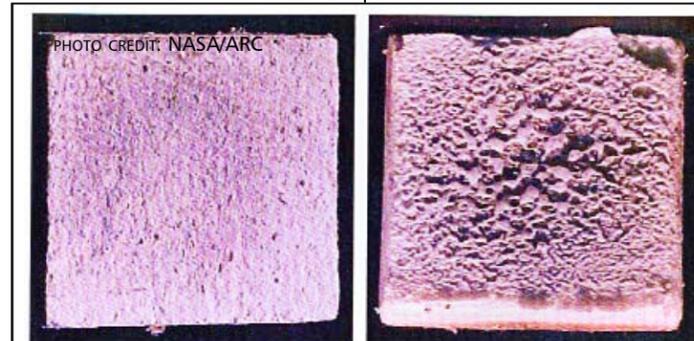
engine efficiency by utilizing fuel more effectively when applied to header pipes. In addition, testing reveals that Emisshield reduces the time a catalytic converter takes to reach operating temperature.

When applied to the exterior header and back exhaust of a V-8 big block engine, Emisshield reduced the temperature inside the racecar, improved engine performance and improved the life of the engine and header pipes. Comparison of an uncoated engine and one coated with Emisshield on an 800-cubic inch, V-8 pro-stock dragster engine resulted in an increase of horsepower, a 26-pounds-per-hour decrease in fuel usage and a decrease by almost half in outer skin temperature.

In addition, the coating has been applied to Xenon headlights, which turn a brownish-color when the internal temperature of the headlamp reaches 900 degrees Fahrenheit because the mild steel structure of the light melts. When coated, the temperature readings with Emisshield were over 200 degrees Fahrenheit cooler and the assembly the headlamp to retain a

blue-colored light.

NASA honored Wessex in June 2003 as a "Turning Goals into Reality" commercial technology award recipient. Ames continues to work with the company to identify other applications for Emisshield related to NASA's current research projects. As well, Wessex entered into partnerships with ANH Refractories of Pittsburgh and Thorpe Corporation of Houston to increase distribution of the coating and is working with various branches of the military on additional testing. ■



TWO SILICON-DIOXIDE-BASED CERAMIC TILES WERE TESTED USING AN OXY-ACETYLENE TORCH HOT ENOUGH TO CUT METAL. THE UNTREATED TILE (LEFT) MELTED AND TURNED TO GLASS BEADS WITHIN 30 SECONDS. UNDER THE SAME CONDITIONS, THE TILE ON THE RIGHT WITH WESSEX'S PCC COATING, WAS TESTED FOR TWO MINUTES AND SHOWED LITTLE DAMAGE.

**Space  
Exploration:**

# THE ROLE OF THE **INNOVATIVE PARTNERSHIPS PROGRAM**

**By Dr. Frank Schowengerdt**

The goals of the Vision for Space Exploration are to implement a sustained and affordable program, extend human presence across the solar system, develop innovative technologies, knowledge and infrastructures, and promote international and commercial participation. NASA's Innovative Partnerships Program (IPP) has a major role to play in achieving all of these goals, but in none more so than making it sustainable and affordable.

How do we sustain this grand vision, over such a long period of time, through multiple administrations and Congresses, and in the face of so many competing national needs? I believe we can sustain it only by consciously and deliberately creating benefits to the public every step of the way and making sure everybody knows it. As the Aldridge Commission put it, "To sustain this program over many presidential administrations and congressional sessions, our leaders must routinely explain and demonstrate the value, affordability, and credibility of the program." And further, "While discovery is the goal of space exploration, the Commission is certain that the benefits here on Earth will make the journey at least as important as the destination."

How do we make the vision affordable so that it fits within the nearly flat budgets that are projected for NASA? One of the ways this can be done is to leverage NASA's investments through partnerships involving companies and universities. In order to make those partnerships a reality,

though, potential industrial partners must be convinced that it is in their economic interests to put up their own money to help NASA get back to the Moon and go on to Mars. The best way to do that is to forge partnerships that can serve both NASA's space exploration needs and the needs of the commercial application partners, both in space and on Earth.

If past experience is any guide, the enhanced commercial activity that will come out of such partnerships will involve all kinds of companies

**Innovative Partnerships... can form the basis of a space economy that can be the engine for carrying humanity out into the solar system and returning benefits to people back here on Earth.**

large and small, aerospace and non-aerospace, high-tech and low-tech. And it will inevitably bring benefits to people here on Earth in ways that we can scarcely imagine now in areas such as telemedicine, autonomous medical care, advanced materials,

satellite communications, ultra-high resolution imaging, intelligent robotics, closed-loop life support, new sources of energy and other space resources, to name just a few.

Innovative partnerships like those being developed in the IPP can have consequences far beyond the research laboratory and the commercial marketplace. They can form the basis of a space economy that can be the engine for carrying humanity out into the solar system and returning benefits to people back here on

Earth. As NASA goes back to the Moon in preparation for its new future in space, such partnerships will increasingly involve private space entrepreneurs in all areas, from launch services to tourism to space resources. Space exploration, after

all, cannot be forever just a government program. It must spawn a truly independent space industry if the ultimate benefits are to be realized.

The Innovative Partnerships Program has a key role to play in making the Vision for Space Exploration sustainable and affordable through partnerships between industry, academia and government. In fostering these partnerships the IPP can also play an important role in the transition of space exploration from a purely government program into one that will involve all segments of society.

The Innovative Partnerships Program, part of the Exploration Systems Research and Technology (ESR&T) office of the Exploration Systems Mission Directorate, consists of the following program elements: Technology Transfer, Small Business Innovative Research (SBIR), Small Business Technology Transfer (STTR), Industry-Led Partnerships and University-Led Partnerships, the latter including the Research Partnership Centers (RPCs) and the University Research Engineering and Technology Institutes (URETIs). Cross-cutting ele-

**"The purpose of the SBIR and STTR programs is to create and mature new technologies through the nation's small business and university research communities."**

ments include industry outreach, coordination with other federal agencies, international cooperation and promotion of benefits to the public.

The National Academy of Public Administration (NAPA) recently reviewed the Technology Transfer program. The results are covered in a report titled, "Technology Transfer: Bringing Innovation to NASA and the Nation." Among its many observations the report found that a comprehensive strategy for identifying technology needs and commercialization opportunities is lacking, the external tech transfer network is fragmented and the roles and responsibilities of component organizations overlap and are unclear.

The NAPA report recommends reformulation and streamlining of the external technology transfer network. That recommendation will be implemented through a new contract to support the efforts of the IPP and the NASA field centers in carrying out

technology transfer functions such as identifying and documenting available technologies in light of NASA's needs, evaluating and prioritizing those technologies, reaching out to find new partners and facilitating the establishment of partnerships. The complete statement of work for the new contract is currently being formulated for inclusion in a Request For Proposal (RFP) expected to be released this year.

The purpose of the SBIR and STTR programs is to create and mature new technologies through the nation's small business and university research communities. The programs are aligned to directly support NASA's four mission directorates, which are Exploration Systems Mission Directorate (ESMD), Science Mission Directorate (SMD), Space Operations Mission Directorate (SOMD) and Aeronautics Research Mission Directorate (ARM D). Because they have historically served the private

THE IPP CAN HELP INFUSE TECHNOLOGY INTO NASA'S PROGRAMS THROUGH EXISTING PARTNERSHIPS, SUCH AS THE RESEARCH PARTNERSHIP CENTERS. THESE PARTNERSHIPS, WHICH HAVE BEEN RECENTLY REALIGNED INTO A DUAL-PURPOSE ROLE, HAVE FLOWN MORE THAN 170 SCIENTIFIC PAYLOADS ON SHUTTLE, MIR AND ISS DURING THEIR 20-YEAR HISTORY.



marketplace, the SBIR and STTR programs now have an inherent dual purpose, as do all the Innovative Partnership Programs.

While infusion of technology into NASA's programs is ultimately the responsibility of the program managers, as was recognized in the NAPA report, the IPP can help through its existing partnerships such as the RPCs. These partnerships, which have been realigned recently into a dual-purpose role, have flown more than 170 scientific payloads on Shuttle, MIR and ISS during their 20-year history. They have demonstrated the ability to develop and fly scientific experiments at a fraction of the cost of traditional payloads. Through their industrial partners, which number more than 160, they have developed new and improved products and processes that have deliv-

ered documented benefits to the public in a cost-effective manner. They have educated hundreds of university students in science and engineering fields that are critical to NASA's exploration goals and also to the Nation's economic well-being. And, they have conducted education and outreach programs that have motivated and inspired thousands of students in K-12 classes and the general public.

Other university-led partnerships such as the URETIs have made significant advances in areas as diverse as nanomaterials and biologically inspired materials. These university-led partnerships will be augmented by a new category of industry-led partnerships that will be designed to pick up technologies at higher Technology Readiness Levels (TRLs) and mature them for possible inser-

tion into ESMD's Constellation Systems or the private marketplace. Such high-TRL technology maturation is more appropriately done in a focused industry setting than in the more diverse university environment where student educational needs are an important factor.

Another new program in the IPP is the Janus Challenge Grant program. Like Janus (Jay'-nus), the Roman god of gates and doorways, who had two faces pointing in opposite directions, this program looks both to the promise of space and to the needs of Earth. It will consist of grants for dual-use research awarded to teams composed of a university principal investigator, one or more industrial researchers and ESMD program element staff from one or more NASA field centers. The grantees will do research and development on topics of interest to NASA that also have application on Earth.

In the IPP, we believe all these kinds of dual-purpose partnerships will be critical to NASA's space exploration programs. While their approaches differ, the overarching goals of all of them working together are to make space exploration more affordable through leveraged partnerships with industry and academia and to make it more sustainable by creating benefits to the public.

Because the very survival of the exploration vision depends on NASA achieving these goals, and because all of the elements within the IPP are agency-wide programs that can contribute to the goals, the IPP will lead NASA in helping to achieve them.

The IPP will take the following steps to fulfill our leadership role:

**1. The IPP will vigorously pursue and promote benefits to the public in all ESMD research and development, including the nurture of external relationships and partnerships of all kinds to aid in this task.**

The IPP office will make use of all of its programs, including Technology Transfer, SBIR, STTR, the RPCs and the URETIs, and through cooperation with the Centennial Challenges program, to foster creation of Earth benefits throughout all of ESMD and NASA.

**2. The IPP will deliberately identify opportunities for creating Earth benefits throughout the ESMD and NASA research and development portfolio.**

This will be done by IPP as the Broad Agency Announcements (BAAs) or other procurement vehicles are rewritten. Language will be included in BAAs conveying NASA's desire that, where feasible and appropriate, research and development activities should lead to public benefits, in addition to meeting an exploration requirement. For the Janus Challenge Grants and the Research Partnership Centers (RPCs) renewal proposals, the dual-use requirement is mandatory.

**3. The IPP will consciously create an environment conducive to pursuing Earth benefits from space exploration research and development.**

Specific actions directed toward producing such an environment will include the following: a strong emphasis on and support of partnerships of all kinds between academia,

government and industry for the creation of dual-use technologies; regular seminars presenting new benefits; prizes and awards for new ideas that create or mature dual-use technologies; Centennial Challenge prizes for

data on Earth benefits. Building upon the highly successful "Spinoffs" database, criteria for inclusion and guidelines for use will be developed that will enhance the utility of the database and turn it into the single, authorita-

...this program looks both to the promise of space and to the needs of Earth

public benefits; and a special fund for research and development in areas related to public benefits that can be used to leverage existing mission-oriented projects, contracts and cooperative agreements to pursue public benefits involving industrial partners.

**4. The IPP will rigorously manage the responsibility for benefits within the Program office through the following actions:**

a. Conduct regular economic analyses of the public benefits of space exploration through the Office of Innovative Partnerships. These studies will be similar to those done by the National Institute of Standards and Technology (NIST), which have proven highly successful. The IPP office will conduct retrospective analyses on individual projects and overall programs for the purposes of verifying benefit claims and advocating for the exploration vision. It also will conduct prospective analyses for the purpose of predicting cost-benefit ratios of planned projects and programs.

b. Improve and expand the means of capturing, validating and storing

tive repository for all Earth benefits stemming from space exploration.

c. Establish a permanent coordinating body, led by the IPP office, and including representatives from the offices of Exploration Systems Research & Technology, Human Systems Research & Technology, Constellation Systems, Public Affairs, Legislative Affairs, Education, and the Outreach coordinators for ESMD, Innovative Partnerships, and SPD. This body will guide and monitor implementation of the plan, ensuring that input to decisions is received from all concerned parties and that all offices having NASA-wide responsibility for dealing with the public are aware of ESMD activities related to Earth benefits.

Implementation of this plan to deliberately and consciously create societal benefits from ESMD and other NASA research is already underway within the Program. The IPP is proud and honored to have the leadership role in this important task and looks forward to working with all of NASA and its stakeholders to achieve the mutual goals. ■

## Preventing Airline Accidents

A tool designed to alert airline analysts to potential, unanticipated problems and to enhance safety and reliability in the industry is available for licensing.

Scientists at NASA's Ames Research Center in Moffett Field, Calif., have developed a "Morning Report" that automatically identifies atypical, or statistically extreme flights, and enable airline flight operations quality assurance (FOQA) analysts to recognize the precursors of incidents or accidents.

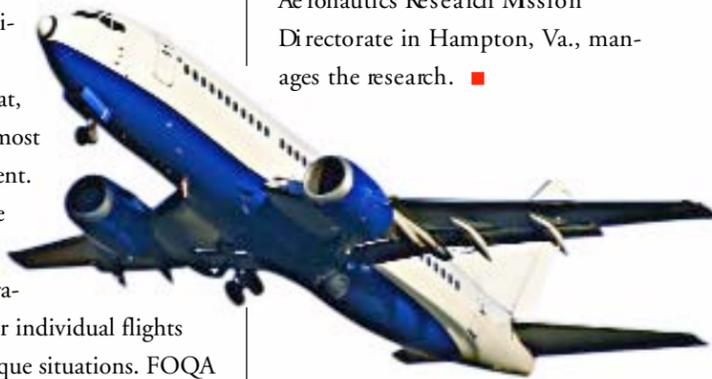
"The Morning Report offers a promising method for identifying unanticipated problems and opportunities in flight data recorded by commercial aircraft," says Thomas Chidester, Aviation Performance Measuring System manager at Ames. "The Morning Report implements concepts from flight science and statistics into practical applications usable in industry."

Only a small portion of the data generated by flights is analyzed through the identification of situations in which aircraft operate outside predefined ranges. The Morning Report tool has the potential to interpret more aircraft data for improved analysis. Unlocking information contained in

data sets could conceivably enhance safety, reliability and the economics of flight operations.

The tool provides airline quality assurance personnel with a list of atypical flights in an easy tabular format, highlighting the most extreme five percent. These can include groups of flights experiencing operational problems or individual flights encountering unique situations. FOQA analysts examine highlighted flights to determine the nature of the problems.

"Our goal is to focus the limited time of experts on analyzing the most operationally significant events, while broadening and deepening their analytical capabilities," says Chidester. "The challenge is finding and understanding key information from the mass of data generated by aircraft and collected by data recorders."



The Morning Report has attracted the attention of industry-leading providers of flight data-analysis software looking to improve their analysis tools. SAGEM Avionics of Grand Prairie, Texas, is the first to license the technology.

"The licensing of this analysis tool from NASA to SAGEM Avionics is another shining example of how NASA-developed technologies are transferred to the private sector to help benefit the American people," says Lisa Lockyer, chief of Ames' Technology Partnerships Division.

NASA's Aviation System Monitoring and Modeling Project under the Aviation Safety and Security Program developed the Morning Report tool. NASA's Aeronautics Research Mission Directorate in Hampton, Va., manages the research. ■

*For more information, contact Mario Perez, Ames Research Center, (650) 604-3778, Mariano.M.Perez@nasa.gov.*

*Please mention that you read about it in Technology Innovation.*

## Piezoelectric Microvalve Technologies

NASA's Jet Propulsion Laboratory is looking for partners to further develop a suite of piezoelectric microvalve technologies.

Two of the technologies have been optimized for precision control of gas flow, with the other two developed for precision control of liquid flow. These technologies allow for the advanced applications originally envisioned for microvalves, particularly in the areas of precision gas and chemical flow control for semiconductor manufacturing, precision dispensing for the life science applications and for applications in micro total analysis systems.

The applications for these active-valve technologies are myriad and include: semiconductor processing where a need exists for normally closed gas microvalves to control the flow of dry-etch gases (for example, microvalves could be components of pressure-based mass flow controllers, vacuum leak-rate shut-off valves and pressure regulators; lab-on-a-chip and micro total analysis systems where low leak rates are required for liquids flowing under high pressure (for example, in chemical and biological monitoring systems and in-situ analysis for both medical and environmental applications where valves must control the flow of molecules); use in the microfluidics that feed samples into a gas chromatog-

raph/mass spectrometer; use in miniature dosing systems for manufacturing and for implantation in veins; use in micro coolers for electronics; use in miniature liquid sample collectors such as those used in oral fluid diagnostics; use in micro-fuel cell/bioreactors for portable electronics; use in DNA sequencing and sorting where microvalves may be needed for integration of a DNA sequencer with other modules of a fully integrated system; and use in fluidic MEMS in general wherever a precise amount of fluid is required. The microvalves have been designed, fabricated, and laboratory tested.

The four technologies offered are designs for fabricating microvalves and are closely related. All of the technologies share these unique features:

The piezoelectric actuator is separately constructed and is then bonded to the rest of the valve body.

The designs employ the use of applied pressure to increase the sealing force.

The designs are optimized for high-pressure operation.

Narrow-edge, "multiple concentric circles" valve seat design and soft material valve body design minimize leak-

age formerly caused by particulates.

The microvalve is normally closed. Piezoelectric actuation provides fast response time – less than 50 milliseconds; low-power consumption – 3 milliwatts at 30V and 2.5 at 20V and 100 milliwatts at 100 cycles per second; and flow control – valve opening controlled by voltage applied to actuator.

The benefits of the technologies include:

Normally closed gas microvalves make possible the control of the flow of dry-etch gases for semiconductor processing.

Very low leak rate microvalves, which meet precision flow criterion for fluids passing through microchannels at high pressures, will improve lab-on-a-chip and micro total analysis systems.

Valve seat and boss design can dramatically reduce the ability of flow particulates present in DNA and cell sorting to stick on the valve seat and create leak paths.

Low-power operation permits longer battery life, or a smaller battery for battery-operated applications, which will reduce cost.

MEMS processing enables low-cost production and small unit size.

The increase in stroke permits a higher flow rate and accommodation of larger particulates, which makes this technology applicable for many commercial microfluidic applications. ■

*For more information, contact Michelle Dougherty, National Technology Transfer Center, (800) 678-6882, mdougherty@nttc.edu.*

*Please mention that you read about it in Technology Innovation.*

# Space Technology Hall of Fame

## 2005 INDUCTEES

The Space Foundation and NASA announced recently the selection of four “down to Earth” technologies for induction into the Space Technology Hall of Fame™.

The 2005 winners range from temperature regulating “phase change” fabrics to advanced water filtration technology that can provide safe drinking water to people around the world. The result of successful NASA and private industry research and development efforts, the four new space-based technologies to be inducted into the Hall of Fame are InnerVue™ Diagnostic Scope System; NanoCeram® Superfilters; Outlast Technologies Inc. Smart Fabric Technology™; and Portable Hyperspectral Imaging Systems. Each brings to Earth a different life-enhancing benefit and all incorporate space technology.

Space Foundation President and Chief Executive Officer Elliot G. Pulham says, “The 2005 Hall of Fame inductees represent space technologies that save lives and improve the quality of life for thousands of people every day. They are great examples of why what we do in space matters on Earth.”

The inducted technologies and innovators were honored at the 17<sup>th</sup> Space Technology Hall of Fame Dinner, held in

April at The Broadmoor Hotel in Colorado Springs, Colo. The awards dinner, co-sponsored by Northrop Grumman, is the capstone event of the 21<sup>st</sup> National Space Symposium.

The Space Foundation, in cooperation with NASA, established the Space Technology Hall of Fame™ in 1988 to honor the innovators who have transformed space technology into commercial products, to increase public awareness of the benefits of space technology and to encourage further innovation. There are many technologies deserving recognition and nominations for induction into the Space Technology Hall of Fame are welcome.

“As we turn our eyes toward the stars, it is important to remember the life-saving and life-enhancing technologies that space exploration brings back to Earth,” says NASA’s Deputy Administrator Frederick Gregory. “The 2005 inductees into the Space Technology Hall of Fame are great examples of how the exploration of space builds value for people on Earth.”

OPPOSITE PAGE: MEDALLIONS GIVEN TO SPACE TECHNOLOGY HALL OF FAME INDUCTEES ARE DISPLAYED DURING THE 17<sup>TH</sup> ANNUAL AWARDS DINNER, HELD IN APRIL AT THE BROADMOOR HOTEL IN COLORADO SPRINGS, COLO.

**The 2005 Space Technology Hall of Fame Inductees are:**

**InnerVue™ Diagnostic Scope System**

The InnerVue™ Diagnostic Scope System uses space image enhancement technology and a disposable micro-invasive endoscope to enable doctors to see clearly inside joints with minimum patient discomfort. With this new technology, for example, patients are able to walk immediately after a knee examination and also receive a quick and accurate medical diagnosis.

**Outlast Technologies Inc. Smart Fabric Technology™**

Derived from research on materials to protect astronauts from extreme temperature fluctuations in space, Outlast "Smart Fabric



PHOTO CREDIT: SPACE TECHNOLOGY HALL OF FAME

systems for spacecraft, NanoCeram® Superfilters were created.

Comprised of nanometer-size particles, these filters far exceed current filtration systems and can handle the most difficult treatment requirements. for industrial, residential and recreational water purification.

**Portable Hyperspectral Imaging Systems**

Hyperspectral imagery provides hundreds of "spectra," or measurements of energy, making it possible to distinguish between natural and manmade objects. Working with NASA, the Institute for Technology Development (ITD) has radically reduced sensor size and eliminated the need for sensor or target motion to obtain images. These innovations have led to a portable device that has opened a range of new diagnostic applications in the bio-medical, forensics, counter terrorism, food safety, and Earth imaging markets.

Hosted by the Space Foundation, the symposium is the world's premier annual space industry conference. Featured speakers for the symposium included The Honorable Dr. Ronald M. Sega, director of defense research and engineering for the Department of Defense; Adm. Timothy J.

**NanoCeram® Superfilters**

The mounting threat of contaminated water supplies has increased the need for technology to remove water-borne pathogens. Thanks to cooperative efforts between NASA and others to develop advanced water filtration

Keating, commander of North American Aerospace Defense Command and U.S. Northern Command; Gen. James E. Cartwright, commander of U.S. Strategic Command; and Gen. Lance W. Lord, commander of Air Force Space Command.

Founded in 1983 and headquartered in Colorado Springs, Colo., the Space Foundation is a national non-profit organization that vigorously advances civil, commercial and national security space endeavors and educational excellence. The Space Foundation has offices in Washington, D.C., and Cape Canaveral, Fla. ■

*For more information, visit [spacetechnologyhalloffame.org](http://spacetechnologyhalloffame.org) or call (800) 691-4000.*

*Please mention that you read about it in Technology Innovation.*

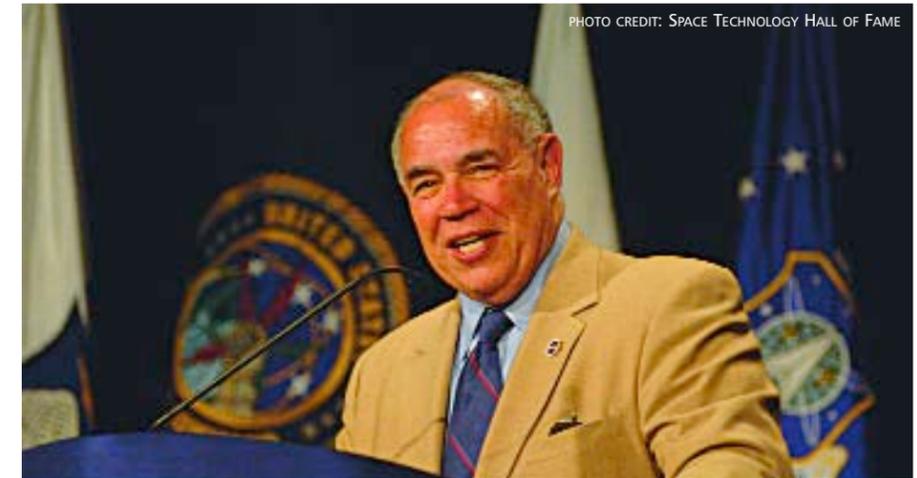


PHOTO CREDIT: SPACE TECHNOLOGY HALL OF FAME

DURING THE SPACE TECHNOLOGY HALL OF FAME INDUCTION CEREMONY, NASA'S DEPUTY ADMINISTRATOR FREDERICK D. GREGORY SPEAKS TO ATTENDEES ABOUT THE LIFE-SAVING AND LIFE-ENHANCING TECHNOLOGIES THAT SPACE EXPLORATION BRINGS BACK TO EARTH.

...the Space Foundation is a national non-profit organization that vigorously advances civil, commercial and national security space endeavors and educational excellence.

Technology™ contains micro-encapsulated phase change materials called Thermocules™ that can absorb, store and release heat. This patented technology is used in a range of consumer products such as active wear to create a comfort zone next to the body.

**NASA**  
**Did You Know?**

An interesting fact to stimulate the mind

What NASA technology is the foundation for implanted pacemakers that can be reprogrammed without requiring additional surgery?

**Technology for two-way communication satellites**

The pacemaker communicates through its wireless telemetry to a physician's computer console. The pacemaker collects data about the patient's heart rhythms and can be programmed to generate the pulses as needed. When the device senses irregular heartbeats, it automatically delivers an electrical stimulus to correct the rhythm.



NASA AMES AND XEROX PERSONNEL CONDUCT A LIVE DEMONSTRATION OF THE NX SYSTEM.

NASA and Xerox Corp. have formed a new technology partnership in which the Stamford, Conn., company will help NASA develop state-of-the-art collaboration and knowledge-management systems, while providing new tools and applications that support NASA's implementation of the Vision for Space Exploration.

By partnering with public companies such as Xerox, NASA will save taxpayer dollars on research and development by using proven technology and expertise to advance agency missions. Xerox also will base a consumer product on the co-developed technology.

"This joint venture combines the best software technology from NASA and Xerox," says G. Scott Hubbard, director of NASA's Ames Research Center in Moffett Field, Calif. "Since both partners bring new technology to the project, we will get new tools tailored specifically for NASA needs in a very cost-effective way."

By yielding innovations that provide software solutions to large-scale problems in information management, the partnership will benefit NASA scientists, affiliates and the commercial sector.

"Working with high-tech companies allows NASA to pursue its mis-

sion of space discovery in a more collaborative spirit, while taking advantage of the best technology the commercial sector has to offer," says Craig Steidle, associate administrator for NASA's Exploration Systems Mission Directorate.

The partnership is already paying

the various missions and project teams at Ames.

One pilot application of this system is occurring at the NASA Astrobiology Institute (NAI). NAI researchers are using NX on a distributed basis across a dozen universities as well as Ames to sort and quickly

"Working with high-tech companies allows NASA to pursue its mission of space discovery in a more collaborative spirit, while taking advantage of the best technology the commercial sector has to offer."

dividends. NX Knowledge Network, a new system that combines Ames' Netmark search and recombination software and content management with collaboration software from Xerox's global research centers, is supporting collaborative research across

analyze data, collaborate and answer questions, such as whether organic life exists on Mars. NX also enables other applications to help manage project risk, investigate mishaps and analyze anomalies.

"Many of the challenges at NASA mirror those of the global commercial enterprise," says Xerox Chief Technology Officer Hervé Gallaire. "We see this as an excellent opportunity to partner two highly sophisticated technical teams to address complex yet real-world information management problems." ■

HERVÉ GALLAIRE (LEFT), CHIEF TECHNOLOGY OFFICER FOR XEROX, WITH NASA AMES RESEARCH CENTER DIRECTOR G. SCOTT HUBBARD (RIGHT) SIGNING THE PARTNERSHIP AGREEMENT BETWEEN NASA AMES AND XEROX.



PHOTO CREDIT: NASA/ARC

For more information, contact David Lackner, Ames Research Center, David.I.Lackner@nasa.gov.

Please mention that you read about it in Technology Innovation.



CONJOINED TWINS MARIA TERESA ALVAREZ, LEFT AND MARIA DE JESUS ALVAREZ PLAY IN THEIR HOSPITAL BED AT UCLA MEDICAL CENTER IN LOS ANGELES.

Two sets of conjoined twins from Guatemala and the Philippines were separated recently. Because the patients' small communities lacked the quality medical care needed to support this delicate procedure, the marathon surgeries were performed in the United States.

In the near future, though, patients might not have to travel great distances for these types of operations. Engineers at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif., are working with doctors on a computer system that might eventually allow high-tech surgeries to be performed in remote countries.

JPL computer engineers have created software that connects information from hospitals all over the world into one virtual pediatric intensive care unit. The system is designed to link doctors who need detailed information with researchers

who are willing to share data about pediatric medicine. For example, a pediatrician in North Carolina who needs information about the most advanced treatment for a child with bone cancer could search the database for the latest medical studies conducted by researchers from all over the country.

The software, called Object Oriented Data Technology, was modeled after the PlanetaryData System, a large software network that helps space scientists translate terminology used in local databases into standard language. Similar software is used to

support the Mars Exploration Rovers, currently exploring the Martian environment.

"The problem has been that information has been generated for local use, and now scientists are discovering the value of sharing research within their various communities," says Dan Crichton, JPL senior computer scientist. "This has been true in planetary science and biomedicine and, now, in pediatric medicine."

With the expanded database, pediatricians can record patient information directly from bedside monitors, regardless of their location. The system stores the

# JPL Software

## Links Pediatricians with

# New Research

information so researchers can use it for clinical trials and for educating other doctors treating patients with similar illnesses.

The virtual pediatric intensive care unit is being developed and tested at Childrens Hospital Los Angeles. This year, the system will be extended to Johns Hopkins Children's Center in

remote areas and assist their colleagues working in isolated centers.

"It is extremely rewarding to see this NASA-funded technology solving a problem of national importance," says Dr. Ken Wolfenbarger, manager of JPL's Innovative Partnerships Program Office. "As part of its mission, JPL welcomes the opportunity to

**"The goal of the virtual pediatric intensive care unit is to enable us to practice in one critical care unit, where we will all have the latest information available to care for critically ill children."**

Baltimore and Cornell University Medical Center in New York.

"The goal of the virtual pediatric intensive care unit is to enable us to practice in one critical care unit, where we will all have the latest information available to care for critically ill children," says Dr. Randall Wetzel, director of critical care medicine at Childrens Hospital Los Angeles. "The fast-paced, compelling urgency, and the overwhelming diversity of diseases seen in children around the world, makes communication among caregivers life-saving and essential, but at the same time, difficult."

The virtual pediatric intensive care unit is ideal for hospitals that lack advanced intensive care units. Over the next few years, engineers hope to install networked cameras allowing doctors to check on their patients in

collaborate with outside companies to develop and transfer dual-use technology through NASA's Innovative Partnerships Program."

There are about 275 pediatric intensive care units around the country. Every year approximately 50,000 infants and children who need constant care are admitted into these units. ■

*For more information, contact Debora Avila, (818) 354-3829, [debora.l.avila@jpl.nasa.gov](mailto:debora.l.avila@jpl.nasa.gov).*

*Please mention that you read about it in Technology Innovation.*



# NASA

## Did You Know?

An interesting fact to stimulate the mind

**Q** What led to the creation of the technology to record images of organs in the human body?

### Digital Image Processing

**A** In the mid-1960s, the Jet Propulsion Laboratory developed digital image processing to allow computer enhancement of Moon pictures. Doctors and hospitals, to record images of organs in the human body, now use this technology. Two of the most widely used techniques are computer-aided tomography (CAT scan) and magnetic resonance imaging (MRI).

# Facility Focus

HIGHLIGHTING A NASA FACILITY THAT PROVIDES FUNCTION BEYOND SPACE EXPLORATION

## NASA Ames Wind Tunnel Operations Division

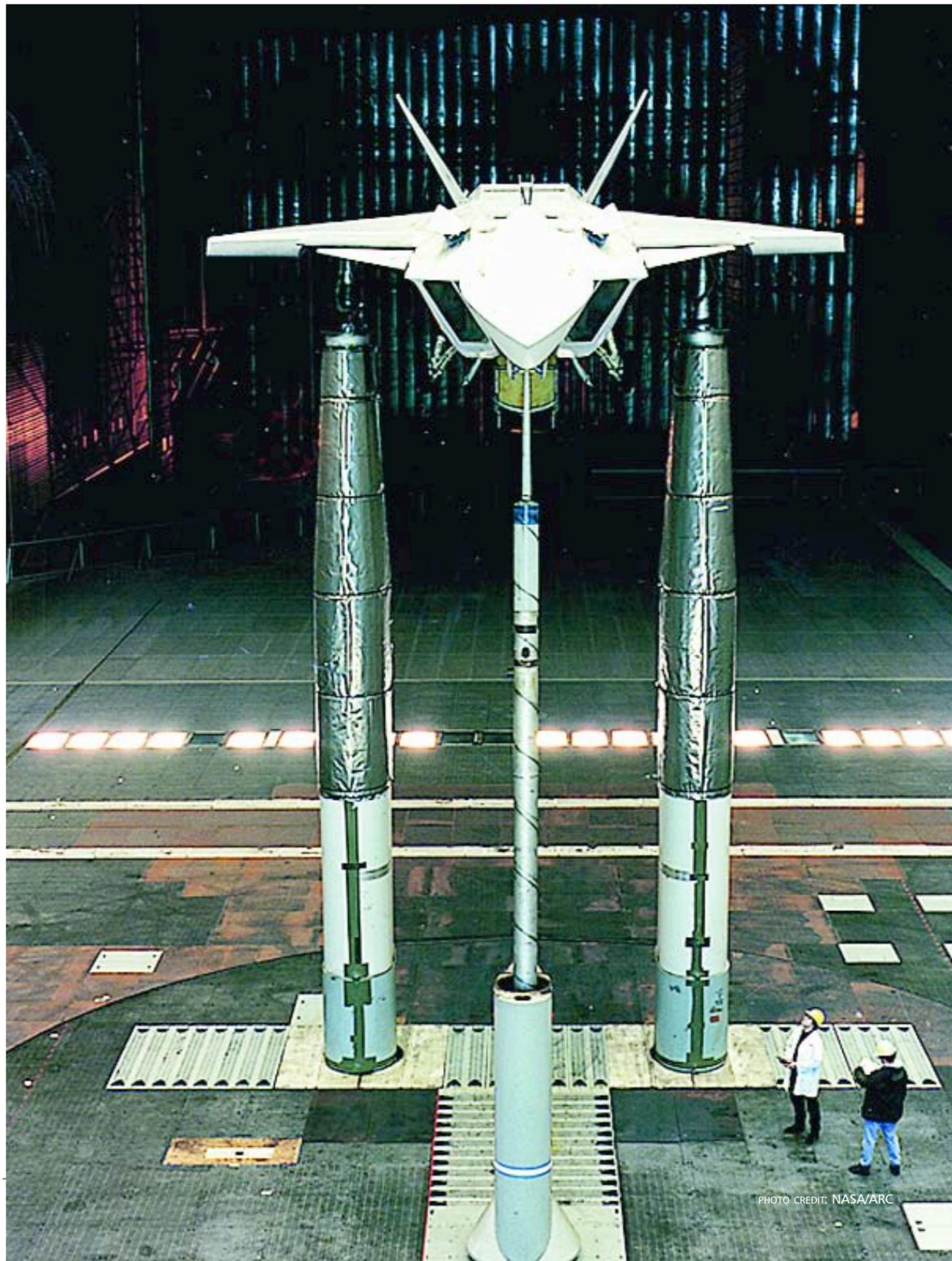


PHOTO CREDIT: NASA/ARC

NASA's Ames Research Center is pleased to offer the services of three premier wind tunnel facilities with a broad range of proven testing capabilities to customers from industry, DOD, other government agencies and academia. Recent facility modernization efforts have also resulted in significant improvements to systems directly affecting both data quality and testing productivity.

Facilities and business practices are just part of the equation, however; skilled people create the difference that makes the testing services a comprehensive and best-value solution. The professional facility teams are available to actively participate in test definition, data analysis, and/or flow visualization coordination, implementation and interpretation.

Customers of Ames wind tunnels also have available a host of NASA's technical and analytical capabilities, including engineering, fabrication, CFD support and consulting and troubleshooting with aerodynamic and acoustic experts. More information about these services is available upon request. The Ames Wind Tunnel Operations Division welcomes all inquiries regarding potential tests in the facilities. Initial contact should be made as early as possible so that a place can be assured on the schedule, and all long-lead items such as hardware design and fabrication can be accomplished. It is best if this initial contact can be made at least seven months before the desired test time. All that is necessary is to fill out a test request form. After review by the Ames Wind



PHOTO CREDIT: NASA/ARC

THE 80x120 WIND TUNNEL WAS USED TO TEST THE FRUEHAUF TRUCK AND TRAILER'S DRAG AND FUEL EFFICIENCY WITH THE LONG-RANGE LASER DOPPLER VELOCIMETER.

Tunnel staff, a test request meeting may be scheduled for further mutual discussion.

The objective is to assure that all customers meet their schedule milestones and leave satisfied with their results and overall testing experience. The wish is to welcome customers back to Ames Research Center to continue sharing in the excitement and challenge of ground-based testing. ■

For more information please visit the NASA Ames wind tunnels Web site at <http://windtunnels.arc.nasa.gov>.

Please mention that you read about it in Technology Innovation.

OPPOSITE PAGE: CALF/JAST X-32 TESTING IN 80x120 WIND TUNNEL.



# NASA, Salinas Hospital Join to Advance Medical Imaging

NASA's Ames Research Center in Moffett Field, Calif., and Salinas Valley Memorial Hospital (SVMH) have announced an agreement to work together to advance future medical-imaging technologies.

**U**nder terms of the agreement, Ames' BioVIS (Biological Visualization, Imaging and Simulation) Technology Center and SVMH will focus on enhancing the quality, accuracy and utility of medical imaging in animal and human models.

"Developing new, accurate medical knowledge will enable us to create revolutionary, noninvasive ways to analyze animals and humans," says Ames Director G. Scott Hubbard.

NASA researchers will use their expertise in image processing and 3-D modeling to develop high-fidelity dig-

ital models of the anatomy and physiological functions of animals.

The standard medical-scanning techniques used today to image internal organs, bones, blood flow and neural function are magnetic resonance imaging (MRI) and computerized tomography (CT) scans. MRI produces high-quality images of the inside of the human body. CT generates a composite image of internal body structures from X-rays taken from different angles. By combining the data from CT, MRI and ultrasound, the newly developed Advanced Digital Animal Physiology Testbed (ADAPT)

will enhance scientists' understanding of cardiovascular anatomy and function without harming an animal.

"Once we're able to fuse the different modalities into one image set, the next logical step is to take that information and apply it to human health. That will be a huge breakthrough in the field of diagnostic imaging," says Thomas Burnside, director of diagnostic imaging at Salinas Valley Memorial Healthcare System.

The hospital will provide NASA scientists with existing medical data and help evaluate the new imaging and segmentation process.



G. SCOTT HUBBARD, NASA AMES CENTER DIRECTOR AND SAMUEL W. DOWNING, PRESIDENT/CHIEF EXECUTIVE OFFICER OF SALINAS VALLEY MEMORIAL HEALTHCARE SYSTEM SIGN SPACE ACT AGREEMENT FOR FUTURE IMAGING TECHNOLOGY COLLABORATIVE RESEARCH.

“We take two-dimensional images from MRIs and CT scans and combine them into a three-dimensional model of the heart, for example,” says NASA’s Dr. Xander Twombly, the technical lead for ADAPT. “The ADAPT system also will model 3-D structures as they deform over time,

vides to NASA will be from patients who have consented to participate in the research. The hospital then will remove the names from each image sent to the BioVIS center, further protecting patient privacy.

“The biomedical modeling research funded through the Human

“We take two-dimensional images from MRIs and CT scans and combine them into a three-dimensional model of the heart, for example”

allowing MRI and CT data to be combined with 4-D cardiac ultrasound. This will allow NASA to generate a continuous time-step model of the heart through a full beat cycle based on a series of data provided by the SVMH.”

All images that the SVMH pro-

Research Initiative is aimed at addressing the Bioastronautics Critical Path Roadmap that defines questions that must be addressed for humans to execute the new Vision for Space Exploration,” says Viktor Stolc, chief of the Gravitational Research Branch in Ames’ Life Sciences Division.

This agreement will be a valuable addition to established collaborations between Ames and hospitals across the country, including Stanford University Medical Center; Johns Hopkins; Beth Israel Medical Center; and the University of California, San Francisco Medical Center.

“This mutually beneficial collaboration will accelerate technology development for our own exploration initiative, while allowing the medical community to provide better health care on Earth,” says Lisa Lockyer, chief of Ames’ Technology Partnerships Division. ■

STANFORD UNIVERSITY HOSPITAL IN PALO ALTO, CALIFORNIA, ASSISTS SALINAS VALLEY MEMORIAL HOSPITAL WITH A DIAGNOSIS, VIEWING IN REAL TIME AN ECHO-CARDIOGRAM OF AN INFANT IN SALINAS.



PHOTO CREDIT: NASA/ARC

For more information, contact Phil Herlth, Ames Research Center, (650) 604-0625, Philip.M.Herlth@nasa.gov.

Please mention that you read about it in Technology Innovation.

## LICENSE AGREEMENTS

NASA provides industry the opportunity to stimulate business investment in the development of new markets on Earth, and to support NASA’s mission and objectives.

Businesses can work with NASA in a variety of ways, depending on the nature of the business, the size of a firm or a particular contract type.

One of the ways NASA works with the private sector is via license agreements.

NASA owns over a thousand patents and patent applications that protect inventions in hundreds of subject matter categories. NASA makes these inventions available to industry through its Patent Licensing Program, which is administered by NASA’s field centers on behalf of the NASA Office of General Counsel, NASA Headquarters, Washington, D.C.

All NASA licenses are individually negotiated with the prospective licensee, and each license contains terms concerning commercialization (practical application), license duration, royalties and periodic reporting. NASA patent licenses may be exclusive, partially exclusive, or nonexclusive. An Exclusive License is a legal document granting intellectual property rights to another party for their sole use in a given field of use or geographic area. A Nonexclusive License is a legal document granting intellectual property rights to an unlimited number of parties in a given field of use or geographic area. A Partially Exclusive License is a legal document granting intellectual property rights to a pre-determined number of recipi-

ents (more than one) for a specific field of use or geographic area. This is also referred to as a Field of Use license.

The patent licensing process generally takes about three to four months after receipt of application for a nonexclusive license. Exclusive licenses take longer and are highly dependent on the complexity of the application. The time frame for exclusive licenses includes a mandatory waiting period of 60 days, during which time a member of the public can file a written objection. Up-front fees generally are set according to the value of the technology and are negotiable.

The percentage in royalties to be paid to NASA under a licensing agreement is negotiable depending on a number of factors, including the type of license issued. It is likely to be between two percent and eight percent of sales.

NASA owns over a thousand patents and patent applications that protect inventions in hundreds of subject matter categories.

Information on NASA patents and patent applications is available from:

- Patent and technical literature searches
- NASA Tech Briefs
- Regional Technology Transfer Centers
- The National Technology Transfer Center
- NASA Field Center Technology Transfer/Commercialization Offices
- NASA Field Center Office of Patent Counsel
- NASA Headquarters Office of General Counsel
- NASA TechFinder ■

For more information about licensing NASA technologies and to access opportunities for technology transfer, visit <http://www.ipp.nasa.gov>.

Please mention that you read about it in Technology Innovation.

# NASA Glenn Earns Three R&D 100 Awards

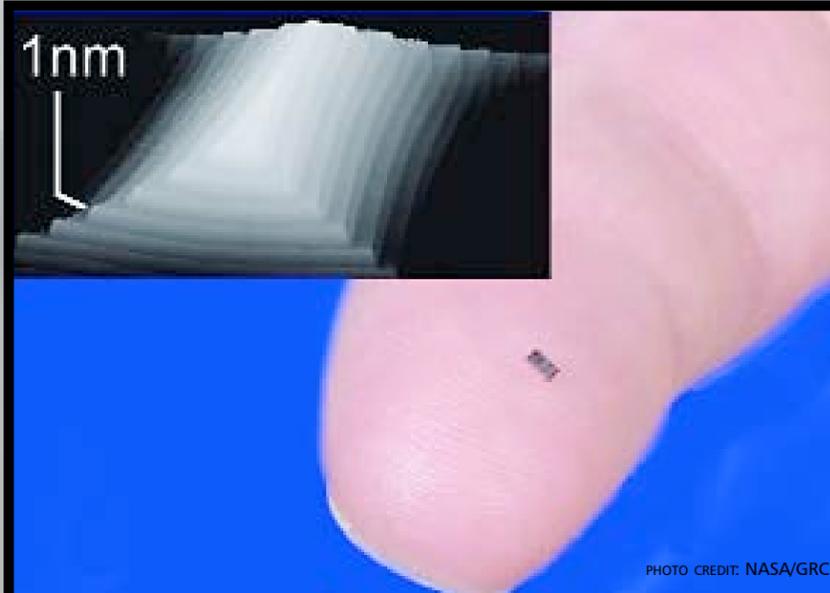


PHOTO CREDIT: NASA/GRC

A NANOMETER STEP HEIGHT STANDARD CHIP SHOWN ON THE TIP OF A FINGER. WITHIN THE CHIP ARE HUNDREDS OF SiC PYRAMIDS, SHOWN ON INSET MAGNIFIED 100 TIMES FOR CLARITY, WITH 1 NM HEIGHT STEPS IDEAL FOR ATOMIC FORCE MICROSCOPE CALIBRATION.

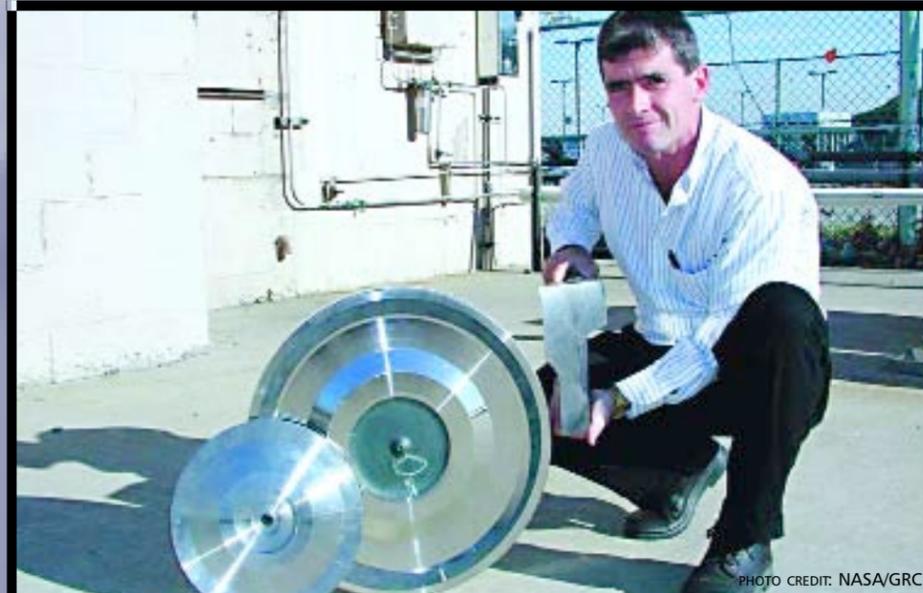


PHOTO CREDIT: NASA/GRC

AIRCRAFT ENGINE DISKS THAT INCORPORATE THE ME3 SUPERALLOY TO IMPROVE ENGINE EFFICIENCY AND PROLONG DISK LIFE.

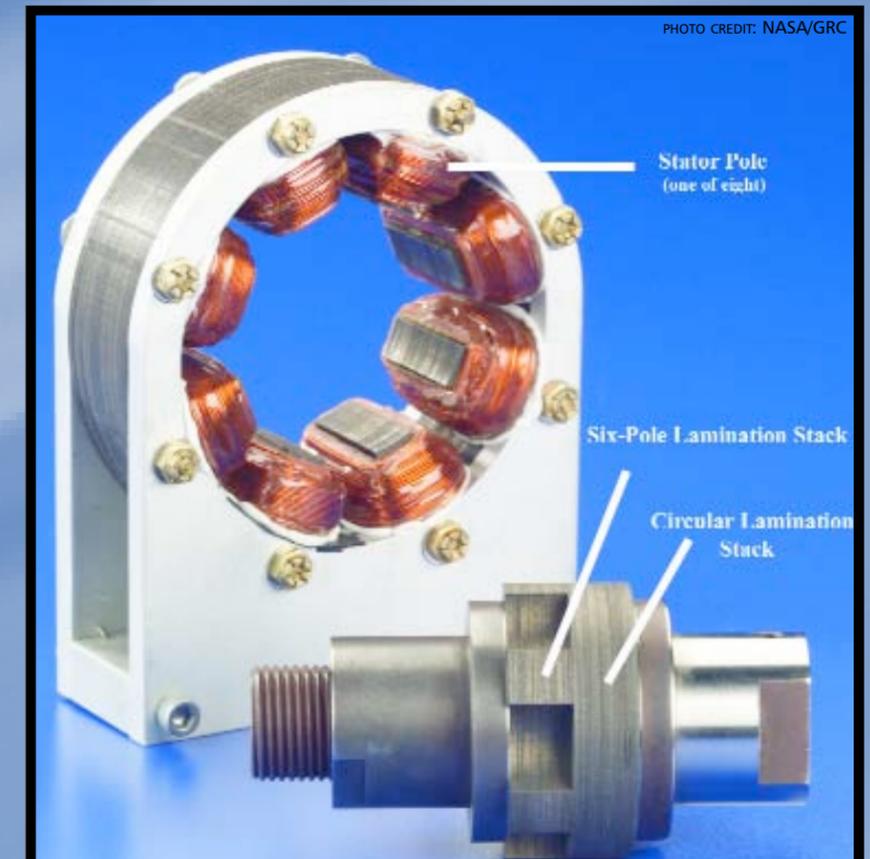


PHOTO CREDIT: NASA/GRC

MORRISON MOTOR SHOWING EIGHT STATOR POLES, SIX-POLE LAMINATION STACK AND CIRCULAR LAMINATION STACK. THE MOTOR IS A COMPACT DESIGN WITH SIMPLE MOTOR CONTROL LOGIC.

Three innovations developed at NASA's Glenn Research Center, Cleveland, are among the top 100 most technologically significant products introduced over the past year into the marketplace, according to an independent judging panel and the editors of R&D Magazine.

The **ME3 Advanced Turbine Disk Alloy**, developed by Glenn materials researchers Michael Nathal, Timothy Gabb and Robert Draper in collaboration with GE Aircraft Engines and

Pratt & Whitney engineers, is a nickel-based powder metallurgy superalloy that will withstand high combustion temperatures for improved engine efficiency and help prolong turbine and compressor disk life. By allowing engines to withstand higher combustion temperatures and pressure ratios, the use of ME3 results in increased fuel efficiency, lower fuel burn and reduced emissions. ME3 is useful for aircraft with longer take-off requirements or high-speed cruise aircraft, such as super jumbo jets, super-

sonic jet aircraft and advanced military aerospace vehicles. Engine manufacturers can also use ME3 at current operating temperatures to increase the time between required engine maintenance, since it is estimated to last nearly 30 times longer than current disk material.

Named for its inventor, Carlos Morrison of Glenn, the **Morrison Motor** operates without a bearing and incorporates a switched-reluctance motor with an 8-pole stator and 6-pole rotor. The motor operates with

magnetic levitation instead of bearings, making it ideal for applications in which large temperature variations or other extreme conditions exist. Reduced overall power consumption and less mechanical noise and vibration are achieved with a hybrid rotor and half the number of windings. Its compact design and simpler motor control logic, coupled with an infinitely variable torque/levitation load ratio, makes the motor an attractive tool for pharmaceutical centrifuges, compact industrial grinders, milling

machines and high-power density motors for aircraft propulsion.

Glenn engineers Phil Abel, Phil Neudeck, in collaboration with Tony Powell and Andy Trunek of Sest Inc., and OAI, have also developed a diagnostic tool to evaluate and verify the operation and calibration of instruments for measuring nanoscale objects. The **Nanometer Step Height Standard** (Nanometer SHS) is a calibration standard with arrays of atomic scale staircases. Each staircase features regularly spaced steps nearly 1 micrometer apart

with atomically flat terraces between step risers of either 0.5 or 1.0 nanometers, as chosen during fabrication. These heights are around 10 times smaller than those of previous standards for scanning probe microscopy calibration. The new devices are fabricated from highly durable single crystal silicon carbide, whose unique crystal properties enable the atomic scale staircase formation. This technology has been patented by NASA and two space act partnerships are in place for commercial application. ■

# Innovative Research

## EXAMPLES OF HOW NASA IS WORKING WITH SMALL BUSINESSES

### SBIR Contracts Lead to Innovative Diagnostic Applications

In 1994, armed with the first generation of remote diagnostic and maintenance software for which it would soon become known as an industry leader, Qualtech Systems Inc. (QSI), of Wethersfield, Conn., began collaborating with scientists at the NASA Ames Research Center on the first of a series of Small Business Innovative Research (SBIR) contracts. Over the next seven years, that research would produce the innovative tools for which QSI would be awarded the 2002 NASA Space Act Award.

What Qualtech created to earn the prestigious award – for significant scientific and technical contributions to NASA’s aeronautical, commercialization and space goals – was a software toolset for designing and developing diagnostic applications such as those required in Integrated Vehicle Health Management (IVHM) systems.

“Integrated vehicle health management systems (IVHM) are an especially important aspect of advanced space missions,” says Dr. Ann Patterson-Hine, leader of the Research in Intelligent Vehicle Automation Group at NASA’s Ames Research Center, who has worked with Qualtech throughout most of the company’s 11-year relationship with NASA. “An effective IVHM tool suite, like the one Qualtech created, makes it possible for you to manage all stages of development, from design through implementation.”

Not only did Qualtech produce a package of design and diagnostic software tools that solved a range of problems for NASA over the course of the past decade, but the tools developed for NASA have formed the foundation of Qualtech’s growing commercial business, as well.



QUALTECH HAS SUCCESSFULLY DEMONSTRATED THE INTEGRATED SOLUTION ON NASA PROGRAMS, INCLUDING THE SECOND GENERATION REUSABLE LAUNCH VEHICLE AND THE INTERNATIONAL SPACE STATION.

Supporting systems engineering, systems design and testability, automated diagnostics and troubleshooting, and system autonomy, the tools QSI developed for NASA during the 1990s are:

- TEAMS® (Testability Engineering And Maintenance System), a tool used in static design/analysis phases of complex systems.
- TEAMS-RT®, a real-time diagnostic engine that provides diagnostic functionality for integrated vehicle health systems on-board a flight vehicle or embedded into a run-time architecture.
- RDS® (Remote Diagnosis Server), an application that can support multiple simultaneous diagnostic sessions from a variety of remote systems.

Working directly with NASA or in partnership with larger companies, Qualtech has successfully demonstrated the inte-

grated solution on NASA programs, including the Second Generation Reusable Launch Vehicle and the International Space Station. The technology and products are now mature, having been flight tested at NASA and on military programs – and deployed in every-day commercial field maintenance operations. Qualtech sees NASA’s new Exploration Program as an opportunity to leverage this technology and the investment that has been made in the TEAMS® tool set.

TEAMS®, the first of the tools QSI produced for NASA, allows system designers to assess performance, facilitating ease of maintenance and diagnostic performance simultaneously during the design phase. Its novel modeling approach, multi-signal flow graphs, provides a simple, efficient modeling representation which can capture a system’s structural and functional relationships. That information is essential to performing diagnostics in the later phases of system development and deployment.

The initial version of TEAMS-RT®, the real-time diagnostic tool, was developed under a contract in support of Ames’ IVHM technology development program for the X-33 vehicle program. TEAMS-RT® was enhanced under two follow-on contracts. Additional capabilities were developed to implement: real-time monitoring and diagnosis in the presence of imperfect tests and temporary failures; ranking and selection of available tests to enable quick and accurate fault isolation; real-time, on-board diagnosis using existing computing resources; and real-time, on-board monitoring and diagnosis under actual flight conditions.

The capability of monitoring software components of highly automated systems was developed under two more NASA R&D contracts. Complex functionality, added to the software, helped to reduce costs and improve reliability in aerospace systems, automobiles and in many safety critical systems. Consequently, any health monitoring solution must consider failures in both hardware and software aspects. A system for automating the monitoring, diagnosis, and troubleshooting of the Unitary Wind Tunnel control systems was developed using TEAMS-RT®.

“This research has been very exciting,” says Dr. Patterson-Hine. “Even today, trying to troubleshoot both hardware and control software simultaneously is very challenging. Not only has QSI demonstrated engineering excellence in addressing NASA’s challenges, but the company has also shown a willingness to listen, carefully, to the needs of their customers and work to really solve their unique problems.”

Further enhancements of TEAMS-RT® resulted in the Remote Diagnosis Server. A distributed diagnostic solution, the Remote Diagnosis Server features ultra-compact memory requirements that enable tele-diagnosis of legacy systems that were not originally designed for real-time, on-board diagnosis. It also offers diagnostic capability for highly connected, network enabled systems.

And that refinement, in turn, led QSI directly to the devel-



INNOVATIVE RESEARCH

opment of TEAMATE, an advanced diagnostic and health management solution that was deployed, last year, to commercial users, including field service engineers (FSEs) of Orbotech Ltd. Orbotech, based in Israel, is a world leader in providing yield-enhancing, production support solutions for specialized applications in the supply chain of the electronics industry, principally for printed circuit boards (PCBs) and flat panel displays (FPDs).

“After an extensive evaluation process, we selected TEAMATE from our short list because of its intuitive knowledge engineering capabilities and its diagnostic accuracy- two critical elements required for maintaining sophisticated inspection systems,” says Oz Desheh, Corporate Director for Customer Support at Orbotech.

Qualtech could not have asked for a better customer to showcase its remote diagnostic capabilities. “Considering the fact that our installed base is spread over three continents, several different languages and time zones, achieving consistent service performance across the entire field force is a challenging objective,” says Shimshon Sayag, Orbotech’s Corporate VP for Operations and Customer Support. “We expect that TEAMATE will help us achieve this objective.”

A direct descendent of the suite of TEAMS® products developed through the NASA research, TEAMATE enables Orbotech to rapidly deliver pinpoint diagnostic and maintenance solutions to FSE’s worldwide.

Faced with an equipment problem, Orbotech FSEs simply enter the initial machine failure symptom(s) or error codes into TEAMATE, which then quickly guides them, step-by-step, through the troubleshooting process, suggesting additional symptoms to look for, which tests to perform, what repair action(s) to take, and, finally, what repair verification steps are needed. Unlike many diagnostic software tools that present FSEs with a range of possible solutions, TEAMATE isolates the root cause for specific faults and swiftly guides FSEs through a single, ideal corrective action.

The TEAMATE solution is based on two components. The first is a graphical modeling tool used by Orbotech engineers to compile their knowledge, experience and expertise into well-structured knowledge bases. The second is a universal diagnostic engine that accesses these knowledge bases and provides optimized troubleshooting guidance on a FSE laptop computer.

“When equipment fails, the challenge is to get it back on line as

quickly as possible. This is particularly critical in today’s manufacturing industry where downtime is incredibly expensive,” says Kevin Cavanaugh, COO of Qualtech Systems. “Given the complexity of Orbotech equipment, mean time-to-repair (MTTR) really hinges upon the skills, experience and knowledge of individual field service engineers. TEAMATE offers a truly revolutionary concept in this regard, because it enables any field service organization to elevate its field service and help desk engineers to an expert level.” ■

*For more information, please visit the SBIR/STTR Web site at <http://sbir.gsfc.nasa.gov/SBIR/SBIR.html>.*

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**Lisa Lockyer**  
Ames Research Center  
Moffett Field, CA 94035-1000  
650/604-1754  
llockyer@mail.arc.nasa.gov

**Dryden Flight Research Center**  
Aerodynamics, Aeronautics Flight Testing, Flight Systems, Revolutionary Flight Concepts, Thermal Testing, and Integrated Systems Test and Validation

**Gregory Poteat**  
Dryden Flight Research Center  
Edwards, CA 93523-0273  
661/276-3872  
greg.poteat@drc.nasa.gov

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Aeropropulsion and Power, Communications, Information Technology, High-Temperature Materials Research, Microgravity Science and Technology, including Bioengineering, and Instrumentation and Control Systems

**Robert F. Lawrence**  
Glenn Research Center  
Cleveland, OH 44135  
216/433-2921  
robert.f.lawrence@nasa.gov

**Goddard Space Flight Center**  
Earth and Planetary Science Missions, LIDAR, Cryogenic Systems, Tracking, Telemetry, Command, Optics and Sensors/Detectors

**Nona Cheeks**  
Goddard Space Flight Center  
Greenbelt, MD 20771  
301/286-5810  
Nona.K.Cheeks@nasa.gov

**Jet Propulsion Laboratory**  
Deep and Near Space Mission Engineering and Operations, Microspacecraft, Space Communications, Remote and In-Situ Sensing, Microdevices, Robotics and Autonomous Systems

**Ken Wolfenbarger**  
Jet Propulsion Laboratory  
Pasadena, CA 91109  
818/354-3821  
James.K.Wolfenbarger@jpl.nasa.gov

**Johnson Space Center**  
Life Sciences/Biomedical, Medical

**Helen W. Lane**  
Johnson Space Center  
Houston, TX 77058  
281/483-7165  
helen.w.lane@nasa.gov

**Kennedy Space Center**  
Fluid Systems, Spaceport Structures & Materials, Process & Human Factors Engineering, Command, Control & Monitoring Technologies, Range Technologies, Biological Sciences

**Jim Aliberti**  
Kennedy Space Center  
Kennedy Space Center, FL 32899  
321/867-6224  
jim.aliberti@nasa.gov

**Langley Research Center**  
Aerodynamics, Flight Systems, Materials, Structures, Sensors, Measurements and Information Sciences

**Bob Yang**  
Langley Research Center  
Hampton, VA 23681-0001  
757/864-8020  
Robert.L.Yang@nasa.gov

**Marshall Space Flight Center**  
Materials, Manufacturing, Non-Destructive Evaluation, Biotechnology, Space Propulsion, Controls and Dynamics, Structures and Microgravity Processing

**Vernotto McMillan**  
Marshall Space Flight Center  
Huntsville, AL 35812  
256/544-2615  
vernotto.mcmillan@msfc.nasa.gov

**Stennis Space Center**  
Propulsion Systems, Test/ Monitoring, Remote Sensing and Non-Intrusive Instrumentation

**John Bailey**  
Stennis Space Center  
Stennis Space Center, MS 39529-6000  
228/688-1660  
John.W.Bailey@nasa.gov

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**Greg Hinkebein**  
Mississippi Enterprise for Technology  
Stennis Space Center, MS  
228/688-3144

**Heidi Brandow**  
Florida/NASA Business Incubation Center  
1311 N. U.S. Highway 1  
Titusville, FL 32796  
321/267-5601

**Bridget Smalley**  
University of Houston/NASA  
Technology Center  
Houston, TX  
713/743-9155

**Richard Reeves**  
Business Technology  
Development Center  
Huntsville, AL  
256/704-6000, ext. 602

**Julie A. Holland**  
NASA Commercialization Center/  
California Polytechnic State University  
Pomona, CA  
909/869-4477

**Martin Kaszubowski**  
Hampton Roads Technology Incubator  
Hampton, VA  
757/865-2140

**Ann Lansinger**  
Emerging Technology Center/  
NASA Business Incubator  
Baltimore, MD  
410/327-9150

Small Business Programs

**Carl Ray**  
NASA Headquarters  
Small Business Innovation Research  
Program (SBIR/STTR)  
202/358-4652  
cray@hq.nasa.gov

**Paul Mexcur**  
Goddard Space Flight Center  
Small Business Technology Transfer  
Program (SBIR/STTR)  
301/286-8888  
paul.mexcur@pop700.gsfc.nasa.gov

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**Paula Webster**  
National Technology Transfer Center  
Wheeling, WV 26003  
800/678-6882

**Ken Dozier**  
Far West Technology Transfer Center  
University of Southern California  
Los Angeles, CA 90007  
213/743-2353

**James Dunn**  
Center for Technology Commercialization  
Westborough, MA 01581  
508/870-0042

**David Bridges**  
Economic Development  
and Technology Ventures  
75 5th Street, Suite 100  
Atlanta, GA 30332  
404/894-6786

**Gary F. Sera**  
Mid-Continent Technology Transfer Center  
Texas A&M University  
College Station, TX 77840  
979/845-8762

**Duncan McIver**  
Technology Commercialization Center, Inc.  
Hampton, VA 23666  
757/766-9200

**Pierrette Woodford**  
Great Lakes Industrial Technology Center  
Battelle Memorial Institute  
Cleveland, OH 44070  
216/898-6400

**Dan Winfield**  
Research Triangle Institute Technology  
Applications Team  
Research Triangle Park, NC 27709  
919/541-6431